Elastic Potential Energy

Elastic potential energy is Potential energy stored as a result of deformation of an elastic object, such as the stretching of a spring. It is equal to the work done to stretch the spring, which depends upon the spring constant k as well as the distance stretched.

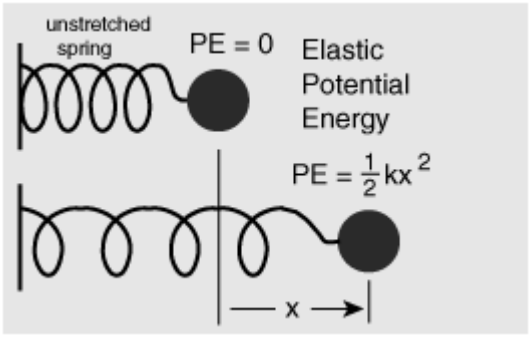
Since the force has the form

$$F = -kx$$

then the work done to stretch the spring a distance x is

$$\text{Work} = PE = \frac{1}{2}kx^2$$

J.

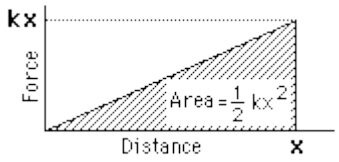


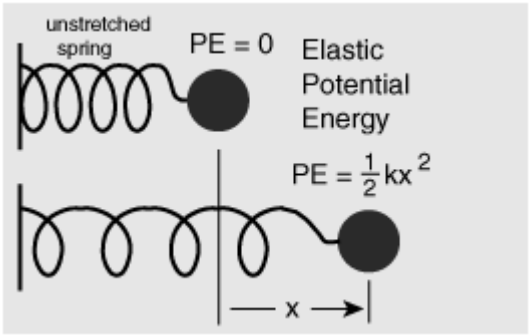
According to Hooke's law, the force required to stretch the spring will be directly proportional to the amount of stretch.

Spring Potential Energy

Since the change in Potential energy of an object between two positions is equal to the work that must be done to move the object from one point to the other, the calculation of potential energy is equivalent to calculating the work.

The work can also be visualized as the area under the force curve:





Elastic Potential Energy Problems – Homework

1. When a 13.2-kg mass is placed on top of a vertical spring, the spring compresses 5.93 cm. Find the force constant of the spring.
2. If a spring has a spring constant of 400 N/m, how much work is required to compress the spring 25.0 cm from its undisturbed position?
3. A compressed spring that obeys Hooke's law has a potential energy of 18 J. If the spring constant of the spring is 400 N/m, find the distance by which the spring is compressed.
4. An object is attached to the lower end of a 100-coil spring that is hanging from the ceiling. The string stretches by 0.165 m. The spring is then cut into two identical springs of 50 coils each. Each spring is attached between the ceiling and the object. By how much does each spring stretch?
5. A vertical spring stretches 10 cm under a load of 200 g.

a. Determine the spring constant.
b. How much work is required to stretch the first 5 cm.
c. How much work is required to stretch the last 5 cm.

6. A mass sitting on a horizontal frictionless surface is attached to one end of spring; the other end of the spring is fixed to a wall. To compress the spring by 0.12 m requires 3.0 J of work. If the mass is released from rest with the spring compressed, it experiences a maximum acceleration of 15 m/s/s. Find the value of the spring constant.
7. To compress spring 1 by 0.20 m takes 150 J of work. Stretching spring 2 by 0.30 m requires 210 J of work. Which spring is stiffer?